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Malacobdella arrokeana (Nemertea: Bdellonemertea), a new species of nemertean from the Southwestern Atlantic Ocean entocommensal in *Panopea abbreviata* (Bivalvia, Heterodonta, Hiatellidae) in Argentina

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Abstract.—*Malacobdella arrokeana,* a new species of entocommensal nemertean is described from the mantle cavity of the bivalve *Panopea abbreviata* in Argentine waters. This discovery expands the distribution of the genus, including the Southern Hemisphere for the first time, and represents a new host record. *Malacobdella arrokeana* can be differentiated from all other species in the genus by the following combination of characters: worm size, length of rhynchocoel, proboscis and retractor muscle of proboscis, gonad distribution and coloration, and position of excretory pores.

Resumen.—Se describe *Malacobdella arrokeana,* una nueva especie de nemertino endocomensal encontrado en la cavidad del manto del bivalvo *Panopea abbreviata* en aguas argentinas. Este descubrimiento expande la distribución del género, incluyendo al Hemisferio Sur por primera vez, y representa un nuevo registro de hospedador. *Malacobdella arrokeana* se diferencia de todas las especies conocidas en este género por la siguiente combinación de caracteres: tamaño, largo del rhynchocel, proboscis y músculo retractor de la proboscis, coloración y distribución de las gónadas, y posición de los poros excretores.

The genus *Malacobdella* is comprised of species with entocommensal habits, typically living in the mantle cavity of bivalve molluscs, especially in species of the families Mactridae, Pholadidae and Veneridae (Gibson 1994). A total of 11 species have been described in the genus. However, some of these have been synonymized with *Malacobdella grossa* (Müller, 1776), whereas others mentioned without full descriptions are considered species inquirenda, leaving five valid species of *Malacobdella.* The species of this genus are difficult to differentiate, partly owing to the great morphological similarity between some of them, and partly because important diagnostic features were not initially recognized as such and therefore are not mentioned in earlier descriptions. In this paper, a new species of *Malacobdella* is described from living and preserved specimens, and compared to other members of the genus.

Material and Methods

Specimens were collected alive from the mantle cavity of 14 specimens of *Panopea abbreviata* Valenciennes, 1839 collected at 6–12 m depth during the months of August, September and October 2000. The nemerteans were relaxed in 7.5% $MgCl_2$ in sea

water for 15–30 minutes, fixed in Bouin's fluid or 5% formalin, and transferred and stored in 70% ethanol. Entire specimens were dehydrated in a graded ethanol series (70%, 80%, 85%, 90%, 95%, 100%), cleared in methyl salicylate, and mounted in Canada balsam as whole mounts. Only specimens fixed in Bouin's fluid and preserved in alcohol were used for histological sections. Cross-sections of four specimens and sagittal sections of one specimen were cut at 8 μm thickness. Some sections were stained with Harris' hematoxylin and counterstained with eosin, others were stained using Mallory's trichrome stain. The proboscis of one specimen was prepared for scanning electron microscopy. It was postfixed in 1% osmium tetroxide, dried with Peldri II (Ted Pella Inc., Redding, California), mounted on stubs with adhesive tape, coated with gold in a Balzeus SCD 40 coater, and examined in a Philips 515 scanning electron microscope. Figures were drawn with the aid of a drawing tube. Photographs of sectioned specimens were made with a Sound Vision digital camera. Museum abbreviations are as follows, MACN: Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina; USNM: Smithsonian Institution National Museum of Natural History, Washington DC, USA.

Results

Class Enopla
Order Bdellonemertea
Family Malacobdellidae
Malacobdella Blainville, 1827
Malacobdella arrokeana, new species
Figs. 1–4

Material examined.—Holotype (Fig. 1) from the mantle cavity of *Panopea abbreviata* Valenciennes, 1839 (Bivalvia, Heterodonta, Hiatellidae); type locality: San José Gulf (42°27′S, 64°35′W); MACN No. 34952. All other specimens used in this study were designated as paratypes, collected from the mantle cavity of *Panopea abbreviata* Valenciennes, 1839 (Bivalvia,

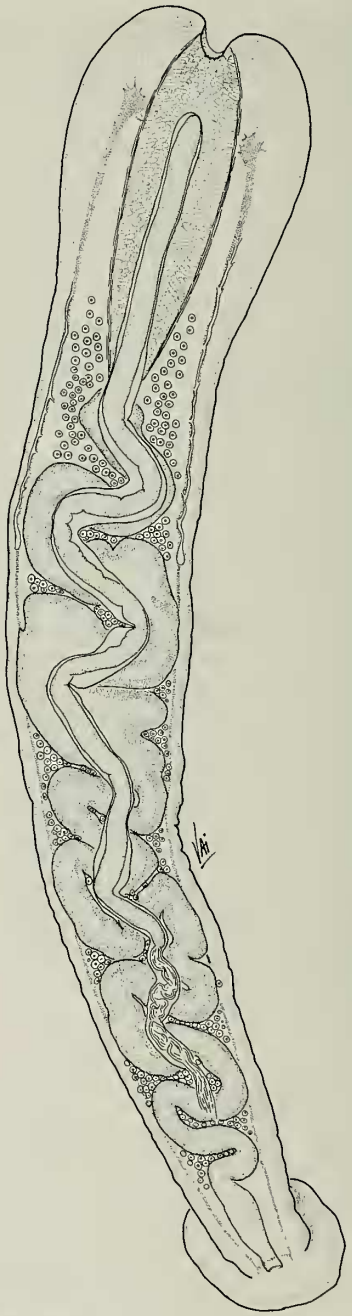

Fig. 1. *Malacobdella arrokeana,* new species. Entire worm, holotype, drawing of a specimen from light microscopy. Scale bar = 3.5 mm.

Heterodonta, Hiatellidae); type locality: San José Gulf (42°27′S, 64°35′W); MACN No. 34953 1/10 (10 paratypes), USNM No. 1001179 (6 paratypes).

Etymology.—From "arrok" = sea in the language of Tehuelches, the prehispanic inhabitants of Patagonia in Argentina.

Description.—The description is based on 54 specimens: 36 stored in alcohol included in measurements of total length and width, 13 whole-mounts, 1 sagittal-section series, 4 cross-section series. Measurements (mm unless indicated otherwise) are from the holotype followed by the range from paratypes in parentheses. Worms elongate, spatulate anteriorly, 22.1 (3.4–59.0) long by 3.4 (0.8–12.0) maximum width at level of cerebral ganglia, 1:6 (1.2–3.0) thick; ratio of body width to length 0.15:1 (Figs. 1, 2A, 3A). Mature specimens 22–59 ($\bar{x}$ = 37) long. Pharynx well developed, 5.9 (0.9–6.4) long by 1.5 (0.4–1.5) wide, occupying 26 (23–38)% of total body length; oval in cross section, internal surface covered by numerous papillae (Fig. 3C). Oesophagus short, 0.34 long, having irregular shape in cross-section (Fig. 3B). Intestine forming 13 (10–14) loops, lacking diverticula; anus opens dorsally, at base of terminal sucker (Figs. 1, 2A, 3A, 4A). Cerebral ganglia 1.7 (0.5–1.7) from anterior cephalic margin, pharyngeal commissure at level of ganglia (Fig. 2A), lateral nerve cords running posteriorly in ventro-lateral position, posterior transverse commissure at level of anus, dorsal to intestine (Figs. 4A, 4B). Rhynchocoel 5.9 (1.9–16.3) long, 0.5 (0.5–0.7) in diameter; originates on dorsal side of pharynx 25 (26–68)% from its anterior; extends posteriorly dorsal to intestine to 81 (62–80)% of total body length (Figs. 1, 2A, 3A); ratio of rhynchocoel diameter to body thickness 0.31: 1 (0.25–0.52: 1). Proboscis occupying 85 (79–98)% of rhynchocoel length (Fig. 1); 0.3–0.5 (0.4) in diameter; external surface densely covered by well-developed conical papillae (Figs. 2B–2D). Retractor muscle of proboscis runs a short distance within rhynchocoel, then passes through rhynchocoel wall and enters the parenchyma, bends dorsally and contacts the muscular body wall at 2.6 from anal opening (Figs. 1, 3F, 3G). Excretory system composed of a number of small branches joined to two dorso-lateral ducts, enlarged at terminal end as an excretory vesicle, opening externally through dorso-lateral pores (Figs. 3D, 3E). Excretory pores at level of 2nd intestinal loop, 8.9 (3.8–9.3) from anterior margin of body [at 40 (33–42)% of body length] (Fig. 1). Sexes separate. Gonads small and numerous, distributed evenly from level of posterior portion of pharynx to terminal sucker, tending to be grouped between intestinal loops (Fig. 1); oval to cylindrical in shape (elongated dorso-ventrally), occupying most of the "parenchyma" in fully mature specimens (Fig. 4C), opening externally through dorsal pores (Figs. 3B, 4D); testes pale rose; ovaries white. Terminal sucker 2.2 (0.6–2.4) in diameter (Figs. 1, 2A, 3A, 4A).

Discussion

Of the 11 species of the genus *Malacobdella* recorded in the literature, only five are considered to be valid (Gibson 1995): *M. grossa* (Müller, 1776), *M. japonica* Takakura, 1897, *M. minuta* Coe, 1945, *M. siliquae* Kozloff, 1991, and *M. macomae* Kozloff, 1991. *Malacobdella anceps* (Dalyell, 1853) and *M. valenciennaei* (Blanchard, 1845) are considered synonyms of *M. grossa* by Gibson (1994, 1995). Three species (viz. *M. cardii* Hesse, 1865, *M. obesa* Verrill, 1892 and *M. mercenaria* Verrill, 1892) need to be re-examined from specimens from type hosts and localities, as suggested by Kozloff (1991), and are best considered species inquirenda at this time. Kozloff (1991) noted that *M. auriculae* Blanchard, 1847 from a freshwater pulmonate gastropod of Chile was described by Blanchard based on drawings made by a colleague. As there is cause to doubt that it is a nemertean, *M. auriculae* is considered species incertis sedis.

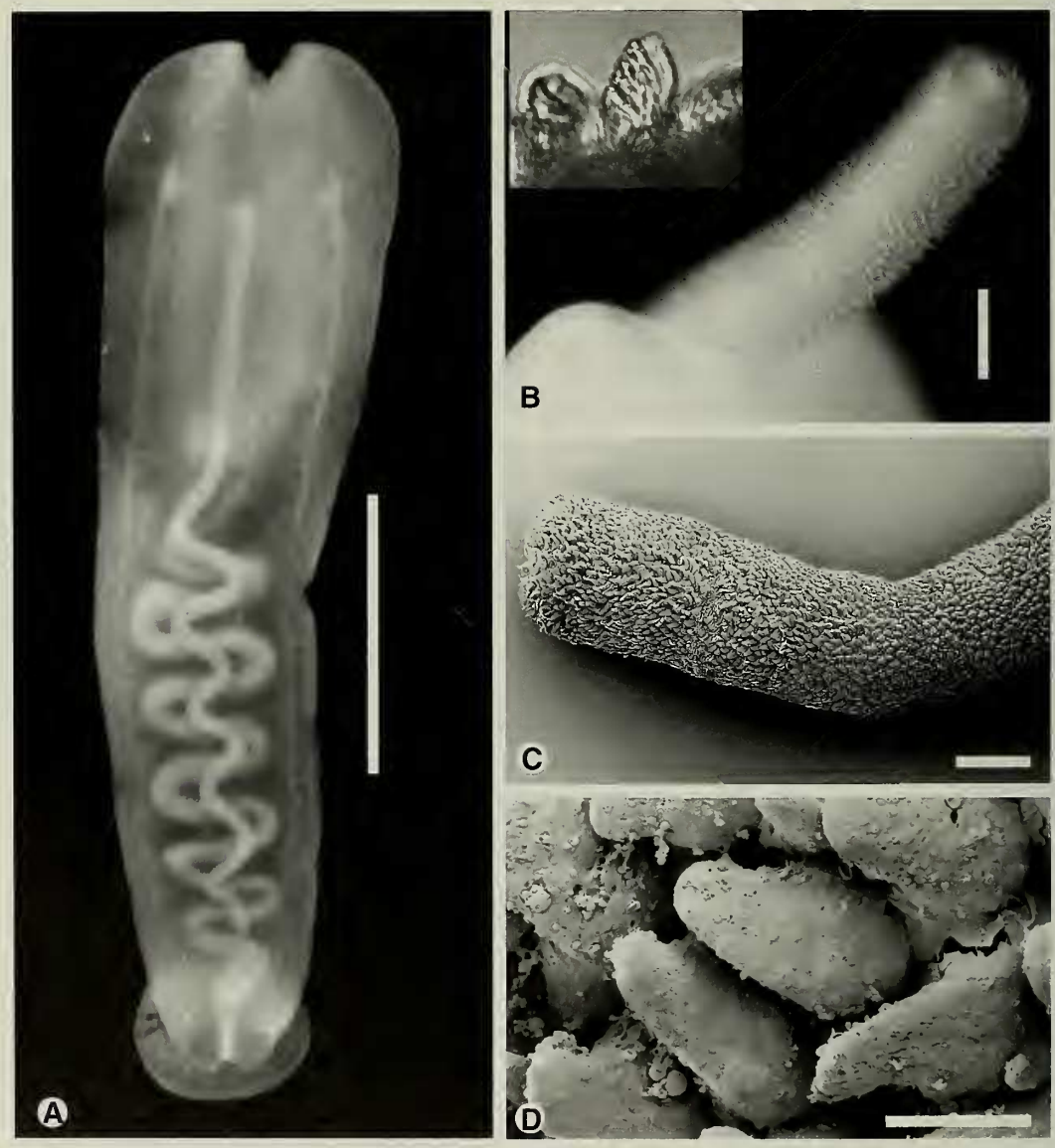

Fig. 2. *Malacobdella arrokeana,* new species. A, Photograph of entire worm; B, Detail of proboscis and papillae on proboscis observed with light microscopy; C, Proboscis surface observed with SEM; D, Detail of papillae observed with SEM. Scale bars: A = 1 mm, B and C = 0.5 mm, D = 0.05 mm.

On the basis of relevant literature descriptions, *Malacobdella arrokeana* new species, can be distinguished clearly from the five valid species as follows:

Based on Takakura (1897) and Yamaoka (1940), *Malacobdella japonica* is about the same size, 45 mm long, vs. 22–59 mm for *M. arrokeana,* but differs in having a posterior nerve commissure around the terminal sucker instead of a dorsal commissure in the posterior part of the intestine just before the anus, as in all other species of *Malacobdella*; the proboscis extends for only two-thirds of the rhynchocoel length in *M. japonica,* whereas the proboscis occupies most of the rhynchocoel, 80–98% in *M. arrokeana*; the retractor muscle of the proboscis is bent ventrally and ends freely in

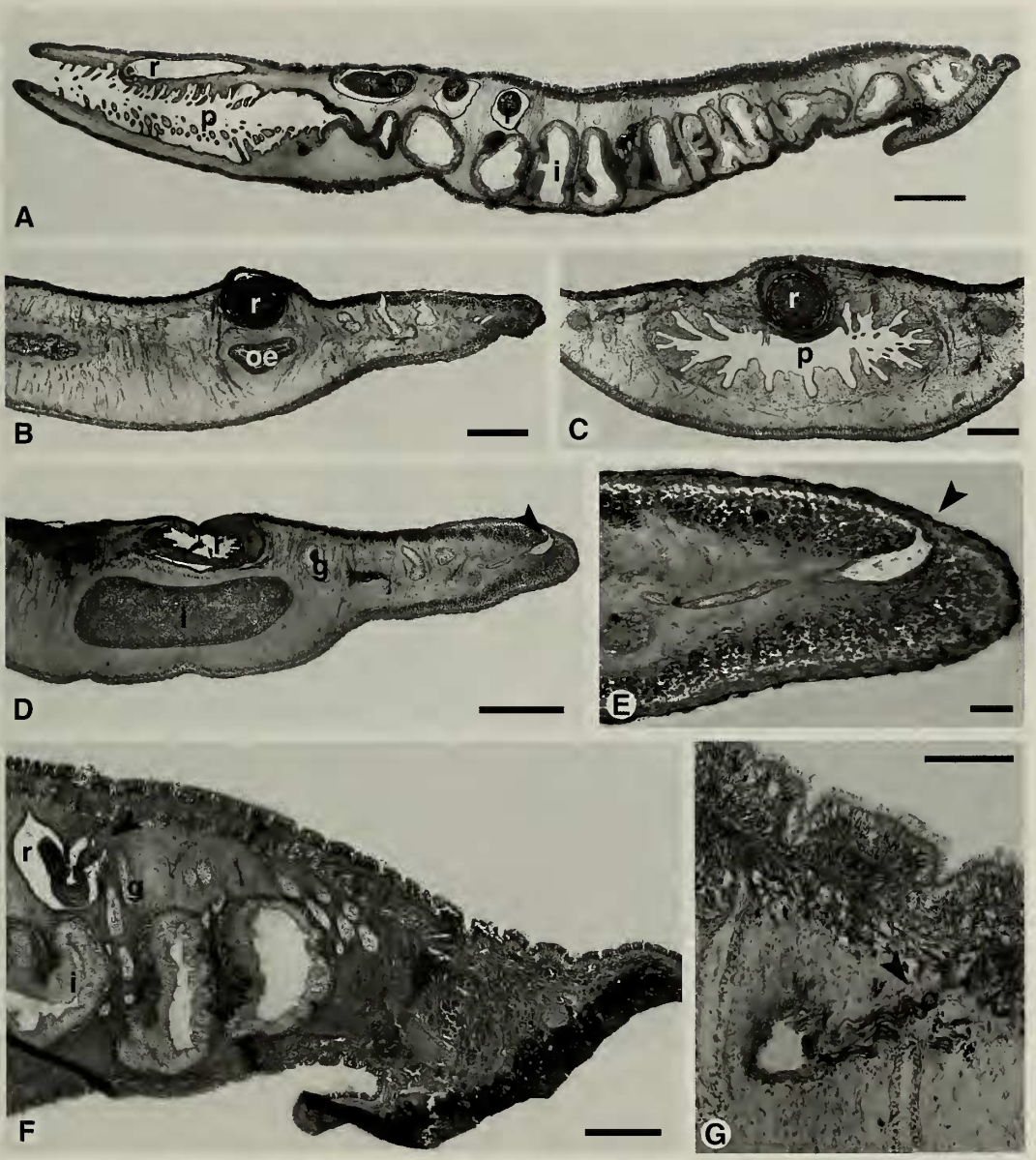

Fig. 3. *Malacobdella arrokeana*, new species. A, Sagittal section of entire worm; B, Cross section at level of oesophagus; C, Cross section at level of pharynx; D, Cross section at level of excretory pores (arrow); E, Detail of excretory pore; F, Sagittal section of posterior end of worm, posterior end of rhynchocoel (arrow); G, Detail of origin of retractor muscle of proboscis. Scale bars: A = 1.0 mm, B, C, D and F = 0.5 mm, E and G = 0.1 mm.

Abbreviations: g, gonad; i, intestine; oe, oesophagus; p, pharynx; r, rhynchocoel.

the parenchyma in *M. japonica,* whereas it is curved dorsally and attached to the body muscular wall in *M. arrokeana.*

As described by Coe (1945), *Malacobdella minuta* is much smaller than *M. arrokeana,* 5–8 mm vs. 22–59 mm; has fewer intestinal loops, 7 vs. 10–14; the proboscis extends for half the rhynchocoel length; testes are white, vs. pale rose in *M. arrokeana*; there are 18 pairs of large gonads distrib-

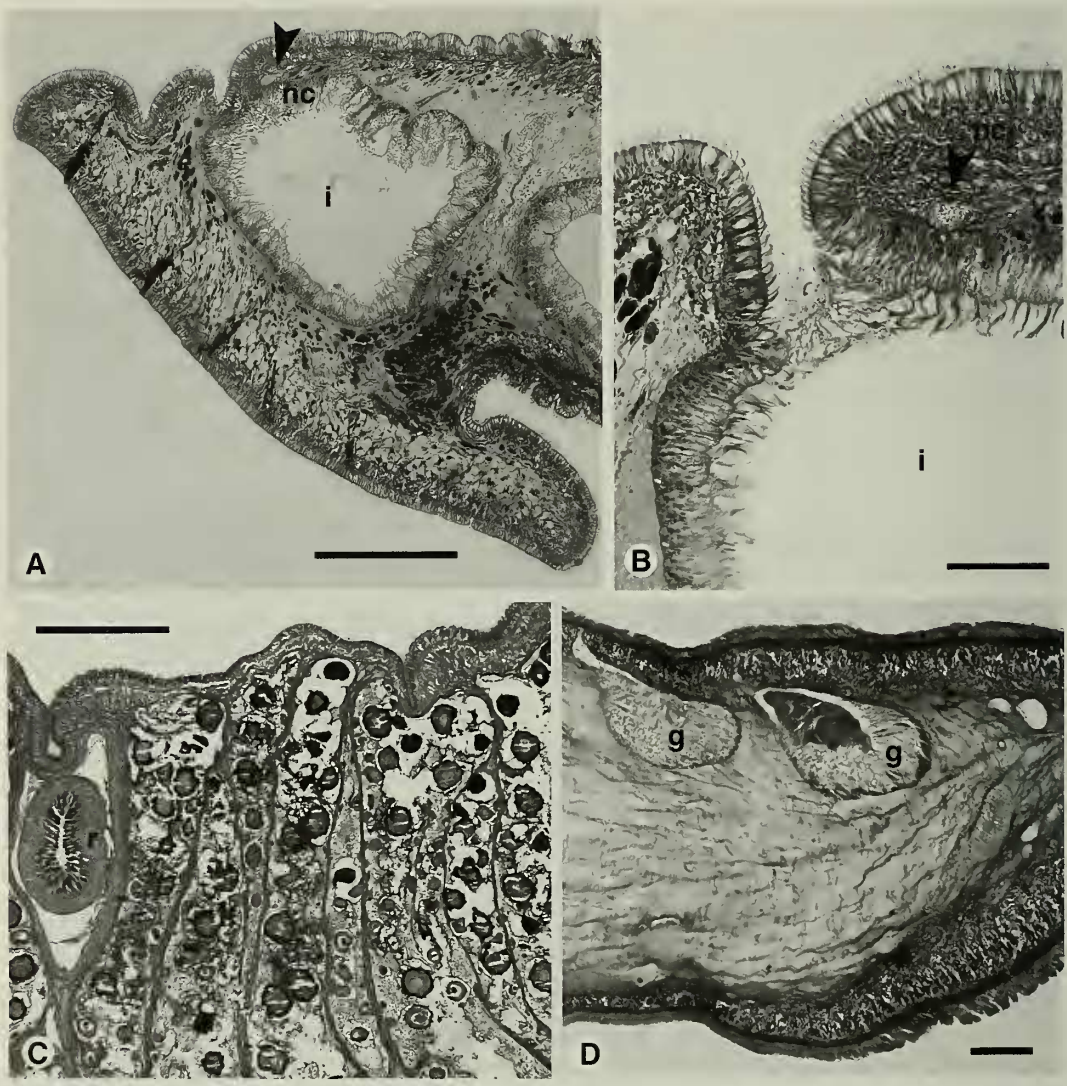

Fig. 4. *Malacobdella arrokeana*, new species. A, Sagittal section of posterior end of worm at level of anus, nerve commissure (arrow); B, Detail of nerve commissure anterior to anus; C, Cross section of mature female; D, Cross section of mature male. Scale bars: A and C = 0.5 mm, B = 0.10 mm, D = 0.1 mm. Abbreviations: g, gonad; i, intestine; nc, nerve commissure; r, rhynchocoel.

uted in a single irregular row on each side of the body, vs. gonads small, numerous and evenly distributed from posterior portion of pharynx to base of the terminal sucker in *M. arrokeana*.

Kozloff's (1991) description shows that *Malacobdella siliquae* is similar in size to *M. arrokeana*, 42 mm vs. 22–59 mm, but excretory pores are lateral, vs. dorso-lateral in *M. arrokeana*; the proboscis extends for half the rhynchocoel length; the ratio of the rhynchocoel diameter to body thickness is smaller, 0.14–0.18:1 (based on figs. 4–7—Kozloff 1991), vs. 0.25–0.59:1 in *M. arrokeana*; gonad color is inverted, with testes white and ovaries magenta, vs. testes pale rose and ovaries white in *M. arrokeana*.

Malacobdella macomae, being very similar to *M. siliquae* according to Kozloff

Fig. 5. Geographical distribution of *Malacobdella* species. ✱ = *M. grossa*, ▲ = *M. siliquae*, △ = *M. japonica*, ● = *M. arrokeana*, ○ = *M. macomae*, □ = *M. minuta*.

(1991), differs from *M. arrokeana* in the same combination of characters described above, with exception of gonad color (not mentioned in the original description—Kozloff 1991).

Comparison with *Malacobdella grossa* is based on Riepen's (1933) description, the most complete morphological study of what has been assumed by subsequent authors to be *M. grossa* (Kozloff 1991), and on Gibson's (1994) account. *Malacobdella grossa* differs from *M. arrokeana* in position of the excretory pores, ventro-lateral vs. dorso-lateral; and ovaries dark olive-green vs. white in *M. arrokeana.* The rhynchocoel and proboscis occupy most of the worm length in both species, but origin of the proboscis retractor muscle is posterior in *M. grossa,* at the level of the ventral origin of the terminal sucker in fig. 9 of Riepen (1933), vs. dorsal in *M. arrokeana.*

Kozloff (1991) suggested that the number of intestinal loops ("undulations") is a good character for distinguishing species. However, we found that this character varied from 10 to 14 (commonly 12) in *M. arrokeana,* independent of worm size. If this observation is a consequence of our larger sample size, the taxonomic utility of this character becomes doubtful.

Malacobdella grossa, according to published records, possesses a low degree of host specificity and has been recorded from 23 species in 17 genera and 11 families of bivalve molluscs, and it is widely distributed on the coasts of Europe and the Atlantic and Pacific coasts of North America (Gibson 1967, 1968, 1994; Gibson & Jennings 1969). Each other species of *Malacobdella* has been recorded from a restricted genus of bivalve mollusc and has a limited geographical distribution (Fig. 5) [viz. *M. japonica* ex *Mactra sachalinensis* Schrenck, 1862 (= *Spisula sachalinensis Schrenck, 1862*) (Fam. Mactridae); *M. siliquae* ex *Siliqua patula* Dixon, 1789 (Fam. Culltelidae); *M. macomae* ex *Macoma secta* (Conrad, 1837) and *M. nasuta* (Conrad, 1837) (Fam. Tellinidae); and *M. minuta* ex *Yoldia cooperii* Gabb, 1865 (Fam. Yoldidae)]. *Malacobdella arrokeana* seems to follow a similar pattern of host specificity, being found only in *Panopea abbreviata* (Hiatellidae) from a total of six species of bivalves studied in the same geographic area [viz. *Aulacomya atra* (Molina, 1782);

Mytilus edulis platensis D'Orbigny, 1842; *Protothaca antiqua* (King & Broderip, 1832); *Eurhomalea exalbida* (Dillwyn, 1817); *Aequipecten tehuelchus* (D'Orbigny, 1842); and *Atrina seminuda* (Lamarck, 1819)]. *Panopea abbreviata* represents a new host record for a *Malacobdella,* and this is the first record of the genus *Malacobdella* from the Southern Hemisphere.

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